

## **FlexRay™ programmable illumination technology**

The semiconductor industry is driven by “shrink” – the ability to make the features that make up chips ever smaller. Shrink improves chip performance and increases manufacturers’ profitability. However, as chip features get smaller so do the tolerances or “process window” that manufacturers must work to. The smaller the process window the harder it is to manufacture chips that work properly.

Lithography is at the heart of semiconductor manufacturing as it makes feature shrink possible. As a leading lithography supplier, ASML is helping drive the industry forward by introducing an advanced new approach to chip manufacturing called holistic lithography.

The ability to optimize multiple IC production steps simultaneously is fundamental to the holistic lithography approach. ASML’s new FlexRay programmable illumination technology allows the mask design and exposure steps to be co-optimized before production begins. This expands the process window, enabling the continuation of shrink and the creation of more advanced chips.

### **Customized illumination**

The illuminator is a key part of any lithography optical system. It conditions the light from the source, and causes the light beam to take on a prescribed shape before it is incident on the mask. This conditioning and shaping of the light is known as the pupil shape.

Different mask patterns work better with different pupil shapes making pupil shape a key factor in ensuring a robust process window for low- $k_1$  production – where process tolerances are approaching the limit of manufacturability. As chip features shrink, more complex pupil shapes are required. FlexRay makes it easier and quicker to create those shapes.

Current illuminator technology uses glass discs called diffractive optical elements (DOEs) to shape the light. For complex pupil shapes, these DOEs have to be custom designed and manufactured. By contrast, FlexRay uses a programmable array of thousands of individually-adjustable micro-mirrors. It can create any pupil shape in a matter of minutes – eliminating the long cycle time associated with DOE design and fabrication and thus accelerating ramp to yield for low  $k_1$  designs.



FlexRay also offers a higher level of control and tighter pupil specifications for both “library” and “custom designed” shapes than previous solutions. This enables better tool-to-tool matching and critical dimension uniformity (CDU), or chip structure accuracy.

With FlexRay, it's as if an unlimited number of DOEs are permanently stored in the scanner. This reduces downtime and re-calibration effort for manufacturers using numerous DOEs in production. The initial pupil set-up time is also reduced to around 10 minutes, and pupil exchange time is just a fraction of a second.

FlexRay perfectly complements other ASML holistic lithography products. Its complete flexibility in pupil shape offers extra degrees of freedom to these packages. Used with Tachyon SMO, it enables fast, efficient source-mask optimization for higher yields. And with LithoTuner Pattern Matcher, it improves Optical Proximity Effect (OPE) matching allowing the same mask to be used on different scanners for higher system availability and fab output.

### **Key features and benefits**

- Creates any pupil shape in a matter of minutes
  - No DOE lead-time
- Tighter pupil specifications than existing solutions
  - 50% better tool-to-tool OPE matching
  - 20% better CDU through pitch
- Enables an unlimited number of “DOEs” to be stored in the scanner
- Improved system availability
  - Less pupil set-up and system calibration time
- Built in redundancy ensures reliability
- Faster, more effective R&D
- 100% backwards compatible
  - Can be used with existing processes

### **Availability**

FlexRay will be offered as a factory option and field upgrade for TWINSCAN XT:1900i, XT:1950i, NXT1950i and future systems. Beta testing will start in Q1 2010 and the first released products will be shipped in Q2 that year.

It will be available both as an individual product and within ASML's application-specific Eclipse™ holistic lithography packages.